ICT APPLICATION IN ACHIEVING PROJECT SUCCESS: A CASE STUDY OF A CONSTURCTION COMPANY IN MALAYSIA

CHUA YONG CHAN

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ABSTRACT

ICT has been shown to be a very important tool in assisting the construction industry to deal with the increasing complexity of projects as well as the increasing demands of clients and regulators. In most developed countries that had raised their fund for ICT investment, it resulted that the productivity has increased within their construction industry. However, Malaysia is slowly adopting ICT in construction industry compare to the other countries. Therefore, this research is to study how the ICT assist in the construction industry and whether it can help in achieving project success. It's also evaluate the factors of ICT applications to see what are the factors that influence ICT implementation. A construction company in Malaysia was chosen to be a case for study. There are totally eight interviewees selected from the high level management of the construction company. The research shows that the factors affecting the ICT implementation include individual, organizational, and technological level factors. Besides that, the result shows that the types of the ICT adopted by the company are covering the electronic communication system, documentation and accounting, quantity surveying, architectural/engineering design and drawing, and also project planning and tracking. The results also show that the ICT can assist in achieving construction project success by meeting the criteria, which are time, cost, quality, scope and customer satisfaction. As a conclusion, ICT is one of the key determinants of the project success. The possibility of the project success will increase if the ICT implementation practices are effective in the construction industry. This study can provide the baseline information for those who want to apply ICT in the construction industry.

TRANSLATION OF ABSTRACT

ICT telah terbukti menjadi alat yang sangat penting dalam membantu industri pembinaan untuk menangani kerumitan projek yang semakin meningkat serta permintaan yang semakin meningkat daripada pelanggan dan pengawal selia. Di negara-negara yang paling maju yang telah mengumpul wang mereka untuk pelaburan ICT, membuktikan produktiviti telah meningkat dalam industri pembinaan mereka. Walau bagaimanapun, Malaysia menggunakan ICT dalam industri pembinaan secare perlahan berbanding dengan negara-negara lain. Oleh itu, kajian ini adalah untuk mengkaji bagaimana ICT membantu dalam industri pembinaan dan sama ada ia boleh membantu dalam mencapai kejayaan projek. Dan juga menilai faktor aplikasi ICT untuk melihat apa faktor-faktor yang mempengaruhi pelaksanaan ICT. Sebuah syarikat pembinaan di Malaysia telah dipilih untuk menjadi kes untuk kajian. Terdapat lapan orang yang dipilih dari pengurusan tahap tinggi syarikat pembinaan tersebut telah ditemuramah. Kajian ini menunjukkan bahawa faktor-faktor yang mempengaruhi pelaksanaan ICT termasuk faktor peringkat individu, organisasi, dan teknologi. Selain itu, hasil kajian ini menunjukkan bahawa jenis ICT yang diguna pakai oleh syarikat itu meliputi sistem komunikasi elektronik, dokumentasi dan perakaunan, ukur bahan, reka bentuk seni bina / kejuruteraan dan lukisan, dan juga perancangan projek dan pengesanan. Keputusan juga menunjukkan bahawa ICT dapat membantu dalam mencapai kejayaan projek pembinaan dengan memenuhi kriteria, iaitu masa, kos, kualiti, skop dan kepuasan pelanggan. Kesimpulannya, ICT adalah salah satu penentu utama kejayaan projek. Kemungkinan kejayaan projek itu akan meningkat jika amalan pelaksanaan ICT yang berkesan dalam industri pembinaan. Kajian ini dapat memberikan maklumat asas untuk mereka yang ingin menggunakan ICT dalam industri pembinaan.

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LIST OF ABBREVIATIONS

ICT	Information and Communications Technology
CAD	Computer Aided Drafting
EDMS	Electronic Document Management System
LAN	Local Area Networks
PDAs	Personal Digital Assistants

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

There are many huge projects that have been done successfully throughout history. However, the projects today are more complicated compared to before. Nowadays, the projects need to involve huge cost, limited time, standard quality and many others. Due to this problem, the Information Communication and Technology (ICT) have developed to influence the project management practice. ICT get the advantage of newly developed management tools and the latest technology (Alshawi and Ingirige, 2003; Kloppenborg, 2009). ICT is emerging and the significance of times nowadays. All the social, national and international also needs ICT to meet the challenges. ICT is penetrating and integrating into every aspect of society day by day. The daily life is increasingly related to ICT. ICT will be generally everywhere like the air in the future. This is the reason for the individuals and organizations to be transformed to ICT widespread use. There is no exception for construction project too.

ICT is accountable for generating, transmitting and interpreting information throughout the construction project process. ICT is responsible every single stage of construction project management, from planning, organizing, leading and closing stages. ICT can improve in the construction industry because it can integrate the existing production, procedure, management activity; provide timely and precise data for decision-making, in order to change the outside world to respond timely and accurately.

Besides that, ICT is needed for improving the organization management level and reinforce the core competitiveness of the construction industry too. For example,

Computer Aided Drafting (CAD) which can create a 3D model of design, apply material and light effects, and document the design with dimensions and other remarks (Peansupap and Walker, 2005). Since that the ICT can bring a lot of advantages to construction industries, so Malaysia should put more effort on finding what factors affecting ICT implementation and which ICT applications currently on the market can help more on achieving project success. This chapter introduces the research outline of this study, which illustrates the problem background, problem statement, research statement, research objective, research questions, research scope, significances of study and operational definition.

1.2 PROBLEM BACKGROUND

Malaysia is a developing country that having stable economic, infrastructure and technology growth. The construction industry is one of the contributors of Malaysia economy. Construction industry provides buildings, infrastructures and facilities and it links to other economic sectors directly such as manufacturing and education. Although the construction industry is only a small part of economics, it is significant (Market Watch Malaysia, 2009).

Malaysia is seen the alertness of ICT since the technology has been invited decades ago. The alertness is increasing as the public knows the significance of ICT usage. There is no exception in the construction industry. Normally the construction project delays can only limit advances in construction quality, cost efficiencies and environmental benefits. The public recognizes the ICT can increase the productivity within the construction industry at the same time can increase the quality, financial control, speed of work, communications and access the common data.

Besides that, transfer information within the construction industry (multinational organizations) is a challenge, mostly when it comes to communication (Lucas and Leyland, 2006). This is because traditional communication methods such as face to face contact are not suitable for transferring information across long distances, within reasonable time. As a result, ICT plays a central role in enhancing information sharing

and it has become a new communication channel that to some degrees instead of the traditional communication methods.

Therefore, ICT become the tools in the construction industry. ICT has been shown to be a very important tool in assisting the construction industry to deal with the increasing complexity of projects as well as the increasing demands of clients and regulators (Betts, 1999), and to improve construction productivity (Liston et al., 2000). There are many case studies about the use of ICT and impact of ICT in the construction industry of various countries had been carried out many times before. They include surveys conducted in Canada in 1999 (Rivard, 2000), South Africa in 2000 (Arif&Karam, 2001), Denmark in 2001 (Samuelson, 2002), Australia in 2001 (Walker, 2001), Malaysia in 2001 (Lim et al., 2002), Turkey in 2001 (Sarshar&Isikdag, 2004), Singapore in 2003 (Goh, 2005), China in 2010 (Li et al., 2011) and Nigeria in 2012 (Usman et al., 2012). This shows that how important is ICT in the construction industry. Therefore, the type of ICT applications and its importance studies in this research to make it clearly how the ICT is vital in assisting the construction industry.

ICT is slowly adopted by key players in the construction industry to operate daily affairs. However, our construction industry is rather slowly adopting ICT technology (Ugwu, 2006). Bookkeeping and hand drawing are still only incidentally applied in the construction industry in Malaysia. The construction industry is faced with the ongoing challenge of changing and improving current work practices in order to become more client-orientated, more competitive as well as productive through adoption of ICT as an integral part of the construction process (Weippert et al., 2003). Somehow for small companies, the cost constraint of adopting ICT in day-to-day operations has become a challenge. Due to the ICT can decrease the time for data processing, communicating information and increase overall productivity of construction project, much more effort need to direct toward the use of ICT in the construction industry. Therefore, the factors of influencing ICT implementation are studied in this research so that we can know the challenges of ICT and improve in realization.

1.3 PROBLEM STATEMENT

Building construction is considered to be an essential element of the construction industry in Malaysia, and it forms about 67.6% of the overall construction work (CIDB, 2000). Therefore, greater emphasize on constructing capabilities become the global challenges. Construction companies cannot focus on immediate interests and ignore the future. The increase probability of project success needs the help of ICT application which can make the organization increase their performance to the project (Peansupap and Walker, 2005).

Communication consumes about 75-90% of a Project Manager's time and information therefore needs to be current and available on demand (Scanlin, 2003). The interpretation of communication is in most cases the root cause of project failures (Scanlin, 2003). Therefore, it is important for construction industries to adopt the ICT application more effectively and comprehensively to make the project life cycle more easily to get success. To adopt the true ICT application is important as a helper in the construction project. Hence, there is a need to answer this question: How the ICT implementation can help in achieving project success in the construction industry in Malaysia?

There are a lot of previous studies are stated that the use of ICT can assist in project management in the construction industry but there is not mentioned that the ICT have directly or indirectly impact on the project, especially the impact of ICT application on achieving project success.

This research is to study how the ICT can assist in the construction industry and whether it can help in achieving project success. It also evaluates the factors of ICT applications to see what the factors that influence ICT implementation. Through this, we can see the reason for ICT rather slowly adopted in Malaysia construction industry and we can improve it.

1.4 RESEARCH OBJECTIVE

The main aim of this research is to explore factors that affecting the ICT application at the same time to study how the ICT can assist in achieving construction project success in Malaysia. Meanwhile, there are three main objectives of this research as below:

RO1: To identify the factors influencing the utilization of ICT in construction project;

RO2: To investigate the types of ICT adopted in conducting the project of the construction industry;

RO3: To study how the ICT applications assist in achieving project success.

1.5 RESEARCH QUESTIONS

The objectives of the present study lead to the following research questions:

RQ1: What are the factors that can influence the ICT implementation decision in the construction industry?

RQ2: What are the types of ICT adopting in conducting projects in the construction industry?

RQ3: What are the influences of the ICT implementation towards the project success?

1.6 RESEARCH SCOPE

For the study of the factors that can affect the ICT implementation, there are a lot of factors had been studied and analyzed by previous studies. However, the technological level factor, individual factor and organizational factor are the main category of factors to study in this research. This is because these three categories of factors are mostly discussed in previous studies. Besides that, these 3 categories of

factors also concluded by Rashid and Al-Qirim (2001), from the macro point of view that related to the process of ICT adoption in companies.

There are many types of ICT applied in the construction industry. Each type of ICT has its own functions and specifications. Those ICT are classified into several categories in this research. The categories are classified according to the area of the ICT application can help most in the process of construction project. The categories are classified by referring to the previous case studies. However, the construction industry is using different types of ICT due to the many factors, especially the factors that are studied in this research.

There is no any specific definition of project success. Different people have different definitions of the project success. The definition is based on what the people decide to achieve and to achieve those requirements are counted as project success. Normally there are three main points that are most important to project success which are meet customer's requirements, on time, and under budget. There is no exception in the construction projects. Normally the project managers define the project success by achieving project complete on time, cost, scope, and quality and customer satisfaction. More details about this are discussed in Chapter 2.

This case study will be conducted in a construction industry in Malaysia. As of 31st December 2010, CIDB Malaysia's record showed a total of 64,924 registered contractors in 2009 (Table 1.1). More than 80% or 52,709 of the contractors were registered under G1, G2 and G3 grades while the rest consists of contractors registered under G4-G7 grades and foreign contractors. However, a construction company in Kuantan, Malaysia was chosen to be studied in this research. The construction company was established since 1989. Starting as a Class D contractor, now the company has grown to become a class B contractor. The company is currently G6 contractor. There is an increasing on the project cost for every year as shown in the Appendix A. This success is the result of work experience obtained, adequate financial resources, manpower professional, skilled and dedicated, and a good relationship with the government agencies involved. Therefore, this company has enough information to be

my interviewee. In addition, this company had experienced the decade of ICT adoption in Malaysia from the beginning until now.

Table 1.1: Number of Contractors by Grade 2009

Grade	Bidding Limit	2006	2007	2008	2009
G1	Not exceeding RM 200,000	36,141	34,581	34,060	33,633
G2	Not exceeding RM 500,000	6,973	7,300	7,516	8,095
G3	Not exceeding RM 1,000,000	10,043	10,572	10,963	10,981
G4	Not exceeding RM 3,000,000	2,140	2,340	2,420	2,613
G5	Not exceeding RM 5,000,000	2,816	3,078	3,363	3,673
G6	Not exceeding RM 10,000,000	1,003	1,065	1,206	1,437
G7	Unlimited	3,736	4,191	4,285	4,326
Foreign	Unlimited	163	163	164	166
	Total	62,979	63,290	63,977	64,924

Source: CIDB Malaysia (2009)

1.7 SIGNIFICANCE OF STUDY

The adoption of ICT in Construction Project Management could improve productivity and increase the quality and speed of work, financial controls, communication, and access to common data (Onyegiri et al., 2011). Therefore, this research study will provide a more detail on the implementation of ICT to achieve construction project success in Malaysia. It brings benefits to those who wish to know more about how the ICT implementation can help in achieving construction project success. The relevant person can increase the efficiency and effectiveness of using ICT on the project so that the probability of project success will be higher. The relevant person also can reduce the probability to meet the stumbling block by understanding the ICT implementation of construction project success. In addition, this research study can provide a detailed analysis of ICT tools that currently use in the market which can really help in project success. The details can be the reference to the construction industry when choosing which ICT to use.

Besides that, this research study can provide baseline information for the contractors and consultants. They can easily decide which ICT to be used. Besides that, this research study can provide selection criteria for the success of a construction project. After this, people may use this as references when doing projects. Implementation of ICT may help the construction project from initiating until closing. If one day I participate in the construction project, this research study will help me a lot. Other people also can use this research study as a reference.

This study will be a significant endeavor in exploring the factor that affects the ICT implementation. This study is to adopt and use as a reference in achieving project success for the effectiveness of ICT implementation. Other researchers also may be able to use these findings in this research study for future studies that will create a huge impact especially in construction field. Therefore, it is anticipated that this research would generate a great deal of interest, not only among construction investigators but also among the general public. Besides that, this research can provide selection criteria for the ICT implementation to the construction industry. They may have a guideline or reference to choose the more suitable ICT application.

In addition, the public can know the ICT implementation with regards to project efficiency performance in the development of construction projects in Malaysia. It is according to the specific requirements and priorities of different project stakeholders. So, when the person steps in construction field in Malaysia, they will have a mindset and clear about this. It can expand my understanding and broaden my knowledge of ICT implementation.

1.8 OPERATIONAL DEFINITION

Information and communications technology (ICT)

ICT is a varied set of technological tools and resources used to communicate, and to generate, spread, keep, and manage information (Blurton, 2002).

Implementation of ICT

Implementation of ICT is defined as the process leading from one practice to a new practice where the new practice is characterized by the use of ICT. The implementation is understood as a mix of management processes, social processes, and processes in which competent individuals decide to start using ICT (Tom Nyvang and Camilla, 2002).

Construction project success

According to Baccarini (1999) project success consists of two separate components, namely project management success and project product success:

• *Project management success* focuses on the project management process and in particular on the successful accomplishment of the project with regards to cost, time and quality. These three dimensions indicate the degree of the 'efficiency of project execution' (Pinkerton, 2003).

• *Project product success* focuses on the effects of the project's end-product. Although project product success is distinguishable from project management success, the successful outcomes, both of them are inseparably linked. 'If the venture is not a success, neither is the project (Pinkerton, 2003). Thus, following Baccarini (1999), in simplistic term project success can be summarized as:

Project success = Project management success + Project product success

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, ICT is studied from the definition of ICT, background of ICT and advantages of using ICT. Besides that, Application of ICT is believed to increase the probability of project success. Different types of ICT application can help in different areas of the project. However, the application of ICT is influenced by some factors. We believe that understanding factors that influence ICT diffusion could provide an essential mechanism to encourage construction organizations to prepare for ICT adoption. Then, the ICT application will be linked to achieve project success and show the relationship between them. All details are discussed in the following.

2.2 INFLUENTIAL FACTORS IN UTILIZING ICT

ICT has attracted a great deal of attention during recent years because a number of companies are implementing ICT, not only education field, but also across the business world (Gargallo-Castel and Galve-Górriz, 2007). It means ICT has become the integral part of individual life as well as part of daily business activity including the construction industry. However, the amounts of company that implement ICT in Malaysia still count as a small number. CIDB has conducted a survey which resulted that the contractors and builders are still not adopting ICT in their daily operations due to reasons such as, the mindset of contractors to only transform resources into the built environment, remote project site and computer literacy (New Straits Times, Leveraging

on ICT usage in construction industry, 13 May 2007). In addition, there are some existing case studies about the drivers, barriers, challenges, enabler, and the factor of ICT implementation (Thong and Yap, 1996; Dutta and Evrard, 1999; Thong, 1999; Walczuch et al., 2000; Utomo and Dodgson, 2001; Duxbury et al., 2002; Drew, 2003; Sarosa and Zowghi, 2003; Peansupap and Walker, 2005; Johansson and Bruun, 2013).

All of the factors influencing ICT implementation make the construction industry become late enter and slow to know the benefits of IT as a major communication tool (Egbu et al., 2001). However, the cost of ICT (computer hardware, software and telecommunication) has fallen in recent years. This makes the companies rethink and redefine whether ICT can help them with more cost effective practices. That's why there are more and more users of ICT in the construction industry during these few years. However, ICT is counted as slow adoption in the construction industry because the study of Fink and Kazakoff (1997) clearly explained the broad potential advantages that an organization could obtain when it adopts ICT in addition to efficiency gains (for example, the automation of clerical procedures), increase management effectiveness (for example, in decision-making) and improve business performance (for example, by entering into strategic alliances with other firms). Therefore, the details of factor that influencing the ICT adoption will be studied, to know the reason of ICT is adopted slowly in the construction industry in Malaysia.

Table 2.1: Analyzing the factors Influencing ICT Implementation

	Sources						
Factors	**1** (Jay et al., 2007)	**2** (Usman et al., 2012)	**3** (Brewer, 2001)	**4** (Li et al., 2001)	**5** (Ali et al,. 2011)	**6** (Brewer et al;. 2012)	**7** (Walker, 2001)
Technological Level Factor	✓	✓	✓		✓	✓	✓	✓

Individual Level Factor	✓	✓	✓	✓	✓		✓
Organization Level Factor	✓	✓	✓	✓	✓	✓	✓
Bureaucracy		✓					
Return on investment		✓					
Myth factors		✓					
Environmental Factor				✓			✓

Table 2.1 shows a summary about the factor of ICT application. The Technological, individual and organization level of factors are mostly discussed and agreed. These 3 categories of factors are concluded by Rashid and Al-Qirim (2001); the macro point of view that related to the process of ICT adoption in companies. These 3 categories of factor studied more details below. However, the levels of the influences of these 3 factors are not indicating the specific periods of the adoption process. So, this research will study the factors affecting ICT adoption.

2.2.1 Technological level factor

The aspect of technological factors includes the complexity and compatibility of the new ICT tools, cost, training and education and guarantee/protection/assurance related to ICT usage (Rashid and Al-Qirim, 2001; Craig Allan, 2003; Peansupap and Walker, 2005; Guo Chao Peng, 2008; Alaghbandrad et al., 2011; Li, 2012). Technological level factor means influences that have an impact on how an organization operates that are related to the equipment used within the organization's environment. The details are discussed below.

Complexity and Compatibility of the New ICT

The compatibility and complexity of the ICT tools as well as employees background technology knowledge belong to the technology level. It affects the adoption and learning of ICT indirectly. The users can learn by themselves if the ICT tools are designed easy-use. However, the users need more motivation from the

management support if the ICT tools are complicated. In addition, if the software's graphical environment is designed same with other familiar programs in the construction field, this may convenience to the users to learn as they have previous experiences in the use of similar environments. ICT developers' support can encourage the users to approach the new technology too.

Cost

The construction industry is very caring about the cost because the cost is their key project success elements. Cost is the primary consideration for majority of the project. So, organization will have good planning on each cost. Therefore, they will not invest too much money in ICT system development and skilled personnel in ICT if they think that it is cost effective (Walker, 2005).

Training and Education

Training and technical support is directly influencing the performance of ICT tools' adopted in construction industries (Vachara and Derek, 2005). Successful implementation of ICT needs continuous investment in human resource development and training (Alam, 2009). The users can use the ICT tools more effectively and easily to be learned by providing a training program to them. Small and medium size firms usually prefer to send their personnel to educational courses out of the firm, but large construction firms usually educate their personnel in the firm (Li et al., 2011). Enough technical support ensures problems of end-users can be timely solved.

Guarantee/Protection/Assurance related to ICT usage

Security of communication channels is a major issue, restricting the degree to which many firms are prepared to engage with an ICT. In particular, the guarantee of information security is crucial for the success of ICT in a project situation – this is only likely to be successfully moderated by a temporary project organization participant(Tan et al., 2010). The most appropriate must exert leadership in terms of ICT protocols for project communication/management(Samuelson and Björk, 2014).Security of

information in ICT tools, strong back up system to avoid data loss, are the main issues which construction professionals worry about them in Iran(Alaghbandrad, 2011).

2.2.2 Individual level factor

Individual factors mainly reflect managers' knowledge and innovativeness (Rashid and Al-Qirim 2001).It is one factor that influences an outcome. It may not be the direct cause, but it has some bearing on who an individual is and what that individual does. Individual level factor include employees' attitude, personal capability to learn ICT and soft skills for professional's interaction.

Employees' attitude

Employees' attitude toward the ICT applications is directly linked with ICT applications usage. The employees' positive attitude toward ICT applications can improve the degree of their use of ICT applications in day-to-day work and vice-versa (Delone and McLean, 1992). In addition, Houghton and Winklhofer (2004) and Houghton et al. (2001) and focus their concentration on the knowledge background of employees. They state that a tendency to decrease the rate of adoption may happen in company if employees have lack of technology knowledge or technical difficulties. Mcbreen (2002) mentioned that due to employees need to change existing attitude and values, adopting a new ICT tool is always tricky.

Personal capability to learn ICT

ICT need skill to use it. If the individual lack of skill may be they will refuse to use ICT. Some employees are reluctance to use because of their education background. They thought that they do not have capability to learn ICT. Personal capability is also related to the user ages. The middle aged or elder users will lack of interest on ICT. They felt that ICT tools are too complicated and cannot learn these technologies easily. A case study on the of ICT adoption in the Iranian construction industry (Alaghbandrad et al., 2011)also mentions this. However, motivation is something that directs, energises, and sustains behaviour; it can make employees to moving from particular position and

keep on going towards the technology. Employees' motivation reflected in personal investment and in cognitive, emotional, and behavioural *engagement* in learning of ICT (Fredricks et al., 2004; Maehr& Meyer, 2004; Reeve, 2006).

Lack of soft skills for professional's interaction

The ways of professionals are interacting with each other has impact especially based on soft skills such as people management, communication management, integration management, team management, culture and industry norms and the like. If professionals cannot deal with these soft issues, it becomes hard for them to use the ICT to share information(Usman et al., 2012).

2.2.3 Organizational level factor

Organizational factors relate to the size of companies, the quality of infrastructure, the specialization areas of the companies as well as the degree of organizational support (Rashid and Al-Qirim, 2001; Li, 2012).Organizational factors are elements and descriptors that define an organization's character, properties, role, and impact. Organizational factors include organizational commitment, attitude, culture, and professionals' soft skills.

Organizational Commitment

Organizational commitment is a vital prerequisite for its successful uptake of ICT (Wong, 2007). Senior management commitment is important both for successful relationship management with stakeholders and human resource development. Employee commitment is required for the success of ICT initiatives. Finally, ICT driven project communications require a culture of trust or transparency with business partners. Larger sized companies more possible to implement new ICT than smaller size companies because larger size companies have more human recourses and can get more commitment and support (Paul and Pascale, 2003).